

Brief article

# Portuguese children's exposure to second-hand tobacco smoke in the family car



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## ARTICLE INFO

### Article history:

Received 22 June 2014

Accepted 27 October 2014

Available online 6 December 2014

### Keywords:

Second hand smoke  
Tobacco smoke pollution  
Child health  
Environmental health  
Epidemiology  
Health policy  
Health promotion

## ABSTRACT

**Objectives:** To assess the prevalence of children's exposure to second-hand smoke in the family car; to compare exposure among children with smoking and non-smoking parents.

**Methods:** In 2011, a self-administered questionnaire was applied to a 4th grade Portuguese children national sample (N = 3187, mean age 9.5 ± 0.7, 51.1% boys). Prevalence rates and chi-square tests were computed.

**Results:** Of the participants, 52.0% reported having, at least, one smoking parent. Overall exposure in the car was 28.9% (95% CI 27.3–30.5). Children's exposure among those reporting smoking parents was 46.9% (95% CI 44.4–49.4); and 8.6% (95% CI 7.1–10.1) among those reporting non-smoking parents (p < .001). Therefore, children with smoking parents were 5.44 times more likely to be exposed.

**Conclusions:** Children's exposure to second-hand smoke in the family car is frequent, especially if one or both parents smoke. This highlights the need for effective tobacco control measures to prevent this severe health hazard.

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## Exposición de los niños y niñas portugueses al humo ambiental de tabaco en el coche familiar

## RESUMEN

**Objetivos:** Describir la prevalencia de la exposición de niños y niñas al humo ambiental del tabaco en el coche familiar; comparar la exposición de niños y niñas con padres fumadores y no fumadores.

**Métodos:** En 2011, se aplicó un cuestionario auto-administrado a una muestra de niños y niñas portugueses de 4º curso (N = 3187, edad promedio 9,5 ± 0,7, 51,1% varones). Se calcularon ratios de prevalencia y pruebas de chi-cuadrado.

**Resultados:** El 52,0% informaron tener al menos un padre/madre fumador. En la muestra total, la exposición fue del 28,9% (CI95%: 27,3–30,5). Esta exposición fue del 46,9% (CI95%:44,4–49,4) entre los niños y niñas con padres fumadores y del 8,6% (CI95%:7,1–10,1) entre los con padres no fumadores (p < 0,001), por lo tanto, fue más de cinco veces mayor entre los niños y niñas con padres fumadores.

**Conclusiones:** La exposición es alta, especialmente si uno o ambos padres fuman. Esto indica la necesidad de medidas de control efectivo del consumo de tabaco para prevenir este severo riesgo para la salud.

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### Palabras clave:

Humo Ambiental del Tabaco  
Contaminación por humo de tabaco  
Salud del niño  
Salud ambiental  
Epidemiología  
Política de Salud  
Promoción de la Salud

## Introduction

Worldwide, more than 600 000 deaths per year are attributable to second-hand smoke (SHS) exposure. Of these, 28% occur among children.<sup>1</sup> The World Health Organization estimates that about half of the children world population is exposed to SHS.<sup>1,2</sup>

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**Table 1**

Prevalence of children's exposure to second-hand tobacco smoke in the family car by parental smoking and region (Portugal, 2011).

Region and Portugal	Parental smoking	SHS in the family car							<i>p</i>	Exposure prevalence ratio <sup>a</sup> (95% CI)
		Yes (regular/occasional)				No				
		<i>N</i>	<i>n</i>	%	95% CI	<i>n</i>	%	95% CI		
Alentejo	Non-smoking parents	63	5	7.9	1.2-14.6	58	92.1	85.4-98.8	<.001	5.73 (2.39-13.75)
Algarve	One/both smoking parents	77	35	45.5	34.4-56.6	42	54.5	43.4-65.6	<.001	6.28 (2.98-13.23)
	Non-smoking parents	94	7	7.4	2.1-12.7	87	92.6	87.3-97.9		
Azores	One/both smoking parents	92	43	46.7	36.5-56.9	49	53.3	43.1-63.5	<.001	2.32 (1.44-3.73)
	Non-smoking parents	59	15	25.4	14.3-36.5	44	74.6	63.5-85.7		
Centre	One/both smoking parents	78	46	59.0	48.1-69.9	32	41.0	30.1-51.9	<.001	5.26 (2.14-12.94)
	Non-smoking parents	69	5	7.2	1.1-13.3	64	92.8	86.7-98.9		
Lisbon	One/both smoking parents	63	24	38.1	26.1-50.1	39	61.9	49.9-73.9	<.001	5.39 (3.83-7.57)
	Non-smoking parents	337	32	9.5	6.4-12.6	305	90.5	87.4-93.6		
Madeira	One/both smoking parents	518	265	51.2	46.9-55.5	253	48.8	44.5-53.1	<.001	7.12 (2.93-17.30)
	Non-smoking parents	100	5	5.0	0.7-9.3	95	95.0	90.7-99.3		
North	One/both smoking parents	118	42	35.6	27.0-44.2	76	64.4	55.8-73.0	<.001	5.93 (4.49-7.82)
	Non-smoking parents	670	51	7.6	5.6-9.6	619	92.4	90.4-94.4		
Portugal <sup>b</sup>	One/both smoking parents	623	281	45.1	41.2-49.0	342	54.9	51.0-58.8	<.001	5.44 (4.55-6.51)
	Non-smoking parents	1392	120	8.6	7.1-10.1	1272	91.4	89.9-92.9		
Total	One/both smoking parents	1569	736	46.9	44.4-49.4	833	53.1	50.6-55.6	–	–
		2961	856	28.9	27.3-30.5	2105	71.1	69.5-72.7		

<sup>a</sup> Exposure prevalence ratio calculated for each region and for Portugal by taking the result of participants with non smoking parents as reference.<sup>b</sup> Portugal corresponds to the total sample, including the 7 main Portuguese Regions: Alentejo, Algarve, Azores, Centre, Lisbon, Madeira and North.*n*: number of exposed or non-exposed; *N*: sample; SHS: second-hand smoke.

SHS is a complex mixture of gases and micro-particles containing nicotine and many other toxic and irritants and several carcinogens.<sup>3–5</sup> SHS is considered the most preventable indoors pollutant. No level of SHS exposure can be considered safe.<sup>2,4,5</sup>

When compared with adults, children have a higher breathing frequency, their liver metabolism and other clearing mechanisms are not yet fully developed, and inhale more air per body weight, resulting in higher exposures. This explains why children are more vulnerable to SHS exposure.<sup>6</sup>

Children's exposure to SHS is associated with poor lung function and several other respiratory health hazards such as asthma, bronchitis and pneumonia, coughing, wheezing and dyspnoea. SHS is also associated with a greater risk for sudden infant death syndrome, middle ear infections and meningitis.<sup>4–6</sup> Children belonging to families with lower socio-economic status are among those most exposed to SHS. In addition, at least one study has reported an association between SHS exposure and smoking uptake.<sup>7,8</sup>

SHS exposure in the car is particularly dangerous due to higher pollutants' concentration in this confined space.<sup>9</sup> Moreover, car interiors are made with materials that retain tobacco smoke pollutants which are dangerous for human health and remain in vehicles' surfaces long time after people finish smoking.<sup>10,11</sup>

Children's exposure to SHS is mainly caused by parental smoking, or by other household smoking. Smoking parents are more permissive to indoors smoking.<sup>12</sup> The current study aimed to determine the prevalence of children's exposure to SHS in the family car and to compare exposure among children with smoking and non-smoking parents

## Methods

This was a questionnaire-based cross-sectional study. In February–May 2011, 3187 questionnaires were administrated in

the classroom to 4<sup>th</sup> grade Portuguese children (mean age 9.5 ± 0.7 years, 51.1% boys).

The sampling strategy combined convenience and random methods.<sup>13</sup> Nine municipalities (Angra do Heroísmo, Braga, Covilhã, Évora, Faro, Funchal, Lisboa, Porto, Viana do Castelo) representing the seven main regions of Portugal (Alentejo, Algarve, Azores, Centre, Lisbon, Madeira and North) were convenience samples. Considering the amount of 4<sup>th</sup> grade students from these municipalities as the total population, and estimating that each class has 20 students, a proportional number of classes per municipality was randomly chosen to participate in the study. Response rate was 77.5%; range: 69.2% (Funchal) to 91.9% (Angra do Heroísmo).

The questionnaire was based on survey tools used in previous studies.<sup>13,14</sup> Core questions assessed: 1) parental/other relative smoking [Does your father/mother/brother(s)/other(s) family member(s) smoke? Answer: no, sometimes, yes]; 2- children's SHS exposure in the family car [Does your father/mother/brother(s)/other(s) smoke in the family car? Answer: always, sometimes and never]. The questionnaire was piloted among a small group of 4<sup>th</sup> grade children and reviewed according to their feedback.

The survey was approved by the Portuguese Ministry of Education. Schools' principals received guidelines regarding parents'/carers' informed consent and the questionnaire application. Trained teachers and research fellows administrated the questionnaires in the classroom following a standardized procedure.

Prevalence rates were computed and chi-square tests were performed using the statistical software *IBM SPSS Statistics* version 22.

## Results

Of the participants, 52.0% reported at least one smoking parent. Overall exposure in the car was 28.9%. Children's exposure was 46.9% among those reporting smoking parents and 8.6% among

those reporting non-smoking parents, ( $\chi^2 = 547.9$ ;  $p < .001$ ). Considering the total sample, SHS exposure was more than five times likely to be higher among children with smoking parents. This trend was observed in all regions, ranging from 2.32 in Azores to 7.12 in Madeira (Table 1).

## Discussion

The results show that for this sample of Portuguese 4<sup>th</sup> school grade school children, more than half has at least one smoker parent and, therefore, being at high risk of SHS and third hand smoke (THS) exposure in the family car. This is caused by their parents' smoking or by their parents' permissiveness to others' smoking in the family car.

The results also suggest that over one quarter of this group of Portuguese children was regularly exposed to SHS in the family car. Almost half of the subgroup with at least one smoker parent was exposed. Almost ten per cent of the children with both non-smokers parents was exposed. SHS exposure was more than five times more frequent in children with at least one parent who smokes when compared with children with no smoking parents. No statistically significant differences were observed amongst the various regions of Portugal included in this study. These findings suggest that Portuguese families are not aware of children vulnerability to SHS and are rather permissive to indoor car smoking.

These results are in line with those reported by other studies, confirming that children's exposure to SHS in the family car is high and strongly related with parental smoking behaviour.<sup>11</sup>

Nevertheless, the current study has some limitations. Firstly, the study used a narrow age range children sample (9–11 years old). This was justified by the need of a compromise between the participants' ages being as low as possible and their capacity to answer accurately to a self-administrated questionnaire. Another limitation is that data is based on perceived self-reported SHS exposure, without parental and/or biological validation. Nevertheless, research indicates that children's self-report SHS exposure is accurate.<sup>15</sup> Thirdly, the sample representativeness at regional and at national level was limited by the sampling method and the small sample size in some regions. All these limitations are explained by budget constraints. Finally, there is no information on participants that do not have or do not use a family car. It is expectable that this information will potentially increase SHS exposure prevalence rates. Despite these limitations, we believe that this is the first study that evaluates Portuguese children's SHS exposure in the family car showing that this prevalence exposure is very high.

These results should be considered unacceptable regarding SHS hazards for children. This risk is totally avoidable since parents and public opinion are aware of its severity.<sup>1–6</sup> The findings support the need for implementing comprehensive tobacco control policies to prevent children's SHS exposure, such as public health campaigns raising awareness on SHS health hazards and promoting smoke-free environments, as well as parental smoking cessation support. Banning smoking in cars, particularly when carrying children, has been considered in several countries. This tobacco control measure should be implemented to prevent children's exposure to SHS.

### What is known about the topic?

SHS exposure is a serious hazard for children. Second-hand smoke (SHS) exposure in cars deserves special attention since pollutants are highly concentrated in this confined space.

Children exposure to SHS results mainly from the smoking of their parents.

### What this study adds to the literature?

Prevalence of children SHS exposure in the family car is unacceptably high. The differences of SHS exposure between children with and without smoking parents are large. Specific actions are needed to prevent this hazard for children.

## Editor in charge

M<sup>a</sup> José López

## Contributions of authorship

All authors significantly contributed to this research project. JP, PDV, JCM, SBR, CS, HA and EB conceived the questionnaire and the study design. PDV, SBR, ACA, MR and JP gathered the data. Data analyses were conducted by JCM, and, to a lesser extent, by PDV. EB and JP supervised data analysis. All authors analysed and interpreted the data. PDV drafted the manuscript with the input of all authors. All authors have contributed to and approved the final manuscript.

## Funding

This work was supported by the Portuguese Foundation for Science and Technology (FCT - Fundação para a Ciência e Tecnologia), grant number PTDC/CPE-CED/098281/2008.

The sponsor was not involved neither on the study design, data gathering, analysis and interpretation of the findings; nor on the drafting and submission of the manuscript.

## Conflicts of interests

None declared.

## Acknowledgments

The authors would like to thank the schools' board, the teachers and students that have participated in the study.

## References

- Oberg M, Jaakkola S, Woodward A, et al. Worldwide burden of disease from exposure to second-hand smoke: A retrospective analysis of data from 192 countries. *Lancet*. 2011;377:139–46.
- World Health Organization. Air Quality Guidelines for Europe. Copenhagen: WHO Regional Office for Europe; 2000.
- International Agency for Research on Cancer. Tobacco Smoke and Involuntary Smoking. IARC. Monographs on the Evaluation of Carcinogenic Risks to Humans. Lyon: IARC; 2004.
- US. Environmental Protection Agency. Respiratory health effects of Passive Smoking: Lung Cancer and Other Disorders. Washington, DC: US Environmental Protection Agency; 1992.
- US Department of Health and Human Services. The Health Consequences of Involuntary Exposure to Tobacco Smoke: A Report of the Surgeon General. Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control and Prevention; 2006.
- Oberg M, Jaakkola MS, Pruss-Ustun A, et al. Second-hand smoke—Assessing the Burden of Disease at National and Local Levels. Geneva: World Health Organization; 2010.
- Bogdanovica I, Szatkowski L, Britton J, et al. Smoking in cars in England: a study of school students in an English city. *BMC Public Health*. 2014;14:559.
- Glover M, Scragg R, Min S, et al. Driving kids to smoke? Children's reported exposure to smoke in cars and early smoking initiation. *Addict Behav*. 2011;36:1027–31.
- Jones MR, Navas-Acien A, Yuan J, et al. Secondhand tobacco smoke concentrations in motor vehicles: a pilot study. *Tob Control*. 2009;18:399–404.

10. Matt GE, Fortmann AL, Quintana PJ, et al. Towards smoke-free rental cars: an evaluation of voluntary smoking restrictions in California. *Tob Control.* 2013;22:201–7.
11. Sendzik T, Fong GT, Travers MJ, et al. An experimental investigation of tobacco smoke pollution in cars. *Nicotine Tob Res.* 2009;11:627–34.
12. Winickoff J, Friebely J, Tanski S, et al. Beliefs about the health effects of thirdhand smoke and home smoking bans. *Pediatrics.* 2009;123:e74–9.
13. Vitória PD, Cunha-Machado J, Araújo AC, et al. Children's exposure to tobacco smoke pollution at home by region: A cross-sectional study. *Rev Port Pneumol.* In press. <http://dx.doi.org/10.1016/j.rppneu.2014.09.007>
14. Precioso J, Samorinha C, Calheiros J, et al. Exposição das crianças ao fumo ambiental de tabaco (FAT). Avaliação de uma intervenção preventiva. *Rev Port Pneumol.* 2010;16:57–72.
15. Avila-Tang E, Elf JL, Cummings KM, et al. Assessing secondhand smoke exposure with reported measures. *Tob Control.* 2013;22:156–63.